

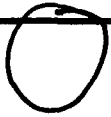

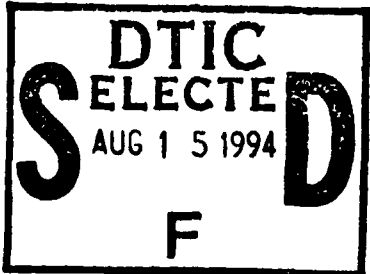
AD-A283 280



## IDENTIFICATION PAGE

Form Approved  
OMB No. 0704-0188

Estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE 19 Apr 93	3. REPORT TYPE AND DATES COVERED FINAL	
4. TITLE AND SUBTITLE THE IMPACT OF THE SOVIET UNION'S DEMISE ON THE U.S. MILITARY SPACE PROGRAM			5. FUNDING NUMBERS 	
6. AUTHOR(S) Gregory A. Keethler Lt Col, USAF				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) AIR WAR COLLEGE 325 CHENNAULT CIRCLE MAXWELL AFB AL 36112-6427			8. PERFORMING ORGANIZATION REPORT NUMBER Unnumbered AWC research paper	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)  N/A			10. SPONSORING/MONITORING AGENCY REPORT NUMBER  N/A	
11. SUPPLEMENTARY NOTES PAPER IS WRITTEN TO FULFILL ACADEMIC RESEARCH REQUIREMENTS FOR AN IN-RESIDENCE SENIOR SERVICE PROFESSIONAL MILITARY SCHOOL.				
12a. DISTRIBUTION/AVAILABILITY STATEMENT  APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) See page iii				
<div style="text-align: right;">6182 94-25468</div> 				
<div style="text-align: center;">  </div>				
14. SUBJECT TERMS Impact, Soviet, Demise, Military, Program			15. NUMBER OF PAGES 35	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLAS	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLAS	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLAS	20. LIMITATION OF ABSTRACT UL	

NSN 7540-01-280-5500

DTIC (QUALITY INSPECTED)

Standard Form 298 (Rev. 2-89)  
Prescribed by ANSI Std. Z39-18  
298-102

94 8 12 018

**AIR WAR COLLEGE**

**AIR UNIVERSITY**

**THE IMPACT OF THE SOVIET UNION'S DEMISE  
ON THE U.S. MILITARY SPACE PROGRAM**

by

**Gregory A. Keethler  
Lieutenant Colonel, USAF**

**A RESEARCH REPORT SUBMITTED TO THE FACULTY**

IN

**FULFILLMENT OF THE CURRICULUM  
REQUIREMENT**

**Advisor: Colonel Ken Walsh**

**MAXWELL AIR FORCE BASE, ALABAMA**

**19 April 1993**

Accession For	
NTIS CRA&I	<input checked="checked" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification .....	
By .....	
Distribution /	
Availability Codes	
Dist	Avail and/or Special
A-1	

## **DISCLAIMER**

**This study represents the views of the author and does not necessarily reflect the official opinion of the Air War College or the Department of the Air Force. In accordance with Air Force Regulation 110-8, it is not copyrighted, but is the property of the United States government.**

**Loan copies of this document may be obtained through the interlibrary loan desk of Air University Library, Maxwell Air Force Base, Alabama 36112-5564 (telephone [205] 953-7223 or DSN 493-7273).**

## **ABSTRACT**

**TITLE:** The Impact of the Soviet Union's Demise on the US Military Space Program

**AUTHOR:** Gregory A. Keethler, Lieutenant Colonel, USAF

The impact of the Soviet Union's demise on the US military space program is counterintuitive. Not only does our increasing dependence on space systems preclude a "peace dividend" from space, but the unspecified regional threats identified in US national strategy documents will likely be equipped with space capabilities much earlier than expected. This is due to the dire economic straits in which the former Soviet space program finds itself--it must market its products, services, and technology to any and all buyers at cut rate prices to earn the hard currency necessary for the program's survival. With little market potential in the West, nations in the developing world--newly awakened by DESERT STORM to the military leverage offered by space--have a high potential to either become customers of the former Soviet space program or employers of its expatriate scientists. Consequently, in addition to maintaining and improving its existing space force structure, the US must vigorously pursue any and all means of achieving space control, both in the sense of denying an enemy use of his space-based force enhancement assets and in the sense of preserving its own.

## **BIOGRAPHICAL SKETCH**

Lieutenant Colonel Gregory A. Keethler, USAF (M.S., Operations Research, Air Force Institute of Technology; B.S., Mathematics, U.T. El Paso) became interested in this project as a means of combining his long standing enthusiasm for military space matters with an opportunity to travel to Russia and Ukraine as part of the Air War College's Regional Security Analysis program. He served in technical assignments as a missile analyst at both the Air Force Armament Laboratory and the Air Force Operational Test and Evaluation Center, and as a mathematics instructor at the Air Force Academy. He has been a staff officer at Headquarters, Air Force Space Command and at Headquarters, United States Southern Command, as well as in the Office of the Secretary of Defense, the Office of the Chairman, Joint Chiefs of Staff, and the Office of the Secretary of the Air Force. He is a graduate of the Armed Forces Staff College, Class 82, where his research on the need to test the U.S. ASAT system led to his being awarded the National Defense University Award for best paper. Lieutenant Colonel Keethler is a graduate of the Air War College, class of 1993.

## TABLE OF CONTENTS

DISCLAIMER. . . . .	ii
ABSTRACT. . . . .	iii
BIOGRAPHICAL SKETCH . . . . .	iv

### Section

1. INTRODUCTION. . . . .	1
2. THE OLD SOVIET SPACE PROGRAM . . . . .	2
3. THE SITUATION IN THE FORMER SOVIET UNION . . . . .	6
4. SPACE PROGRAM IN TRANSITION . . . . .	10
5. ENTERING THE INTERNATIONAL SPACE MARKET . . . . .	12
6. WHERE TO TURN . . . . .	15
7. THE IMPORTANCE OF SPACE ASSETS IN MODERN WARFARE . . . . .	17
8. THE PROLIFERATION OF MILITARY SPACE CAPABILITY . . . . .	20
9. IMPACT ON THE US MILITARY SPACE PROGRAM . . . . .	22
First: There is no "Peace Dividend" in Space . . . . .	23
Second: It is time to get serious about Space Control. . . . .	25
10. SUMMARY . . . . .	29
NOTES . . . . .	31
BIBLIOGRAPHY . . . . .	46

## **I. INTRODUCTION**

*One small ball in the air, something which does not  
raise my apprehension, not one iota.*

**President Eisenhower**  
Commenting on Sputnik<sup>1</sup>

Despite his apparent lack of appreciation for the extent of the atmosphere, Ike's reaction to Sputnik was technically correct: the thing was basically just a radio beacon in orbit, and it should have surprised no one because the Soviets had openly expressed their intent to launch a satellite for over two years.<sup>2</sup> Nevertheless, the President's attempt to downplay the event fell on the deaf ears of a nation gripped by the specter of Soviet nuclear weapons reaching the US through space. Virtual panic set in, and the so-called "space race" was born. Over the ensuing 34 years, the US and the Soviets conducted over three thousand successful space launches, about two-thirds having primarily military purposes.<sup>3</sup> By 1991, the U.S. was spending over \$14 billion per year just on the military portion of its space program.<sup>4</sup>

Then, in December of that year, the Soviet Union collapsed. Given the intensity of the aforementioned "space race," there are surely profound implications for the US military space program. Intuition suggests the time is ripe to scale back US military space efforts--to adjust our force posture away from space in the absence of our traditional space competitor to not only save money but also to revert the use of space to peaceful purposes. By examining the impact of the Soviet Union's demise on the military space arena in light of other developments in the world and US national security strategy, this paper argues that no such opportunity exists. Indeed, the case is made that the course of events in the Former Soviet Union (FSU) argues not only for maintaining and improving our existing space force structure, but, more importantly, for even greater emphasis on the military space mission area known as space control.

The paper begins by briefly reviewing the old Soviet space program before turning to the current political and economic situation in the FSU. It then discusses

how this situation has forced the space program in the FSU to enter the international commercial space market as a matter of survival. An analysis is then presented of how this will accelerate space technology proliferation in the Third World and how, in light of our national security and military strategies, our military space force posture is affected. The paper concludes with a summation of the argument.

## **2. THE OLD SOVIET SPACE PROGRAM**

*Space at last presented the Soviets with a forum in which they could--in the short term--humiliate the Imperialists... with an offer... to provide the United States aid under their backward nations assistance program.*

**Nicholas L. Johnson**

**in Soviet Military Strategy in Space<sup>1</sup>**

Soviet leaders relished the nation's reputation as the world's "premier spacefaring nation,"<sup>2</sup> and they touted the program "as proof of the superiority of socialism over capitalism."<sup>3</sup> The program's propaganda value contributed to "almost indiscriminate expenditures" being lavished on it,<sup>4</sup> and by almost any measure, it became the world's largest space program.<sup>5</sup> The industry to support it grew to between 800,000 and 900,000 workers<sup>6</sup> in over 2,000 enterprises, 90 percent of which were in Russia.<sup>7</sup> The Soviets developed over 50 types of spacecraft and 10 different launch systems,<sup>8</sup> which were employed in over 101 launches in 1982, the peak year in terms of launches.<sup>9</sup> On the verge of collapse in 1991, the Soviet Union still mustered 59 successful launches, far exceeding the rest of the world combined.<sup>10</sup>

Cloaked in secrecy and tightly controlled by the Communist party, the program was dominated by the needs and desires of the military<sup>11</sup>--according to one former Russian space science official, military activities accounted for 85-90 percent of the program's budget.<sup>12</sup> Not only did the five military services finance most of the Soviet satellites, but they also launched them, trained the cosmonauts, performed all spacecraft recovery, and did most of the satellite tracking.<sup>13</sup>



**The phenomenal number of launches manifests a very fundamental difference between the Soviet and US approaches to their respective space programs. In his book, Nicholas Johnson summarized this difference as follows:**

**Simply put, the United States has come to rely upon a very few long-lived and sophisticated satellites to fulfill specific tasks, while the Soviet Union maintains many shorter lived and simpler spacecraft to perform the same functions. . . . The frequency with which satellites must be launched dictates that launch vehicles as well as satellites must be standardised . . . and virtually mass-produced.<sup>14</sup>**

**Whereas launch preparation and checkout times for the Soviets were normally measured in days, comparable US times are measured in months. This is according to General John L. Piotrowski, the former commander of United States Space Command, who also found a graphic example to illustrate the contrasting launch capabilities of the two countries: "During the Falkland Islands crisis in 1982, the Soviet Union conducted 29 space launches in 69 days, comparable to the US launch totals in 1986, 1987, and 1988 combined."<sup>15</sup> In all fairness, US launch figures for those years were depressed due to the Challenger disaster and other booster problems, but the point is well taken. Johnson goes on to develop his primary thesis:**

**Soviet satellite philosophy closely parallels the philosophy evident in other areas of Soviet industry and military weaponry: the paramount design qualities are ruggedness, simplicity, relatively low cost of manufacture and operation, mission effectiveness, and proliferation. These attributes are not only the trademark of the Soviet presence in space, but reflect a military space strategy designed, should the need arise, to fight and to win a war in outer space.<sup>16</sup>**

**Still later in the book, Johnson says: "To Moscow the prospect of war in space is not a notion to be shunned for romantic ideological reasons, rather it is a logical eventuality for which serious preparations must be made."<sup>17</sup> Such high officials at the time as Secretary of Defense Weinberger and Secretary of the Air Force Aldridge held similar views of Soviet space strategy.<sup>18</sup> For purposes of this paper, the important point is that to the Soviet military, space forces were clearly an integral part of warfighting strategy and doctrine, and it stands to reason that this strategy and doctrine was**

passed on to the military institutions that survive in the Soviet successor states. Thus, from a military perspective, space is likely no less important to the military institutions of the FSU than it was to their Soviet predecessors.

As space funding began to dry up, the Soviets started looking for ways to cut costs while maintaining the same capability. A 1991 Department of Defense publication entitled Military Forces in Transition said "trends indicate that Soviet satellites are gradually becoming more sophisticated and longer lived. This increased efficiency is the mark of a more mature military space program that can reduce redundancy while accomplishing its missions."<sup>19</sup> While undoubtedly the same time-tested design features persisted, the point is that it is a fallacy to conclude that the Soviet satellites were technological dinosaurs that no one else would ever want.

Nevertheless, selling space products and services to outsiders was not of particular interest to the Soviets. Commercial activity was a low priority, accounting for no more than four percent of the program.<sup>20</sup> Under Perestroika, more emphasis was placed on commercial activity with the creation of Glavkosmos in 1985 to internationally market Soviet space services and products.<sup>21</sup> Although the Gorbachev government had high hopes that the space industry would be an engine of growth,<sup>22</sup> the commercial endeavor met with little success.<sup>23</sup> When the space budget was made public in 1989, there was a public outcry against the level of resources being spent at a time when the economy was rapidly deteriorating, prompting Boris Yeltsin and others to campaign on freezing the space budget.<sup>24</sup> By 1991, the financial pressures on the Soviet space program had reached the point that, according to Aviation Week and Space Technology, the Defense Ministry "offered its secret Military Satellite Control Center for lease to any non-Soviet group for use to command commercial or scientific space missions" in order to generate hard currency.<sup>25</sup>

Three of the Soviet Republics possessed the bulk of the space program and its supporting industry. It has already been noted that 90 percent of the space industry

was in Russia. Ukraine produced various equipment such as sensors and launch vehicles, and it hosted a major satellite tracking station as well.<sup>26</sup> Two of the three launch complexes, or cosmodromes, were in Russia, including Plesetsk, the most active one with 60 or more launches per year in the mid-eighties. The third launch complex was Baikonur Cosmodrome in Kazakhstan, which was the site of the first Sputnik launch and served as the launch site for all manned, lunar, planetary, geosynchronous, and high altitude navigation missions as well as about one-third of the photographic reconnaissance satellites.<sup>27</sup>

To summarize, the foregoing discussion has highlighted a number of features of the old Soviet space program that are relevant to analyzing the current course of events: first, the program was an immense source of pride for the Soviet Union; second, the space industry was, collectively, a tremendously large endeavor that employed large numbers of highly skilled people; third, the space program was the beneficiary of virtually unlimited funding; fourth, the military was far and away the largest customer of that industry, was deeply involved in the program, and considered space warfare to be fundamental to warfighting doctrine and strategy; fifth, access to space through unparalleled launch capability was a strength of the program; sixth, Soviet satellites were rugged and low cost, yet reasonably capable; seventh, until very late in the program, commercial applications of the space program were a very low priority; and finally, the primary "space republics" were Russia, Ukraine, and Kazakhstan, with Russia possessing most of the infrastructure.

The Soviet Union's collapse in December, 1991, intensified the political and financial pressure on the space program. To fully appreciate the current state of affairs in the former Soviet space program, it is worthwhile to explore the context in which the program is trying to survive.

### **3. THE SITUATION IN THE FORMER SOVIET UNION**

*Events in Russia were their usual mess today.*

**Tom Brokaw  
NBC Nightly News  
29 March 1993<sup>1</sup>**

For obvious reasons, the world's focus on the FSU's trials and tribulations gravitates to Russia, and Mr. Brokaw's matter-of-fact comment amply captures the seeming endlessness of Russian political machinations in the wake of the Soviet Union's collapse. The most recent episode had the Russian parliament failing in its attempt to impeach President Boris Yeltsin in an ongoing battle for control of the government. There are many complex dimensions of the situation, the complete exploration of which would consume several papers the length of this one. For purposes of this paper, suffice it to say that the political future of Russia is uncertain at best: predictions run the gamut from a return to authoritarianism to ultimate success of Yeltsin's democratic and economic reform movement to chaos and civil war.<sup>2</sup> Meanwhile, as confusion reigns at the highest levels of government, various other factions such as government apparatchiks, the military, factory managers, and the like struggle to consolidate and retain their own share of power. As early as November 1992, The Economist assessed the country as all but ungovernable due to the competing policies of such groups.<sup>3</sup>

The political entropy pales in comparison to the precipitous plunge of the failing Russian economy, which has been variously described as "imploding," "collapsing," "an economic swamp," and a "basket case."<sup>4</sup> The economic indicators paint a gruesome picture: the ruble is inflating at an annual rate of at least 2000 percent<sup>5</sup>; 1992 production was nearly 30 percent below 1990 levels<sup>6</sup>; the ruble, which exchanged at 200 per dollar as late as September 1992, slipped to almost 700 per dollar by February 1993<sup>7</sup>; debt payments in 1993 will reach \$40 billion, or \$5 billion more than expected revenues from exports<sup>8</sup>; and the US Treasury department estimates the 1993

GDP to be \$75 billion, only \$10 billion more than the output of the embattled IBM Corporation.<sup>9</sup> Real per capita income has declined 57 percent in two years, and in January 1993, Russians were paying 8688 rubles for a basket of goods that cost them 100 rubles in December 1990.<sup>10</sup> To put this in perspective, as of September 1992, the average Russian wage was about 6,000 rubles per month, while pensioners averaged less than 1,000 rubles per month.<sup>11</sup> The upshot of all of this is that the space program in Russia at this juncture is affected far more by economics than by politics.

The factors contributing to the economic calamity are both many and interrelated--again, a complete analysis is beyond the scope of this paper. However, one very significant factor germane to the issue at hand is the military industrial complex, of which the space industry is a part, because it reportedly constituted half of Russia's industrial production prior to the Soviet collapse.<sup>12</sup> Declining arms sales<sup>13</sup> have combined with defense budget cuts of over 65 percent,<sup>14</sup> to render this capacity largely excess. Hence, weapons production is off at least 50-60 percent, while research and development work fell 33 percent in 1992 after a 50 percent reduction in 1991.<sup>15</sup> Yet, many managers have attempted to keep employees on the payroll although they produce nothing.<sup>16</sup> In the critical absence of either export revenues or Western investment and aid,<sup>17</sup> the government is thus faced with the dilemma of either printing more money to prop up these industries or letting the unprofitable enterprises fail and opening the floodgates of unemployment.<sup>18</sup> Thus far, it has attempted the former course by operating the presses that print rubles at full capacity, around the clock, every day of the week.<sup>19</sup> The predictable result is the runaway inflation discussed above.<sup>20</sup>

The Russian government announced in January that it would stop ceaselessly printing money and thereby allow unprofitable enterprises to go under,<sup>21</sup> but inflation continues as other former Soviet Republics continue to print rubles.<sup>22</sup> The unprofitable enterprises are more often than not design bureaus and machine building

enterprises of the military industrial complex with large numbers of engineers and highly skilled workers. Those who are not joining the ranks of the unemployed receive one-half to one-third of the wages earned by workers in more commercially profitable enterprises like textiles. Out-of-work engineers, many of them women, often take low-skill, low-paying jobs as a necessity--if they can find such jobs at all.<sup>23</sup>

Rampant inflation, steeply declining industrial output, a dismal market for military exports, a shriveling standard of living, increasing unemployment, and an overall export level below that needed even to service the national debt all translate to an absolutely desperate need for hard currency. This is the principal motivation behind the Russians' frantic pleas for Western aid and investment. It is, therefore, an astonishing and very significant fact that in the face of such an urgent need, the government cannot control the exodus of precious hard currency from the country: a French banking analysis firm estimates that \$17 billion in hard currency left the country illegally in 1991 and 1992--about one dollar for every four in legitimate exports. This is largely done through diversion of export commodities via "unofficial channels"--estimates are that one-third of all Russian oil reaching the West is handled this way, as is one-half of the nickel.<sup>24</sup> General Valery Krasnovsky of the Russian Security Ministry succinctly summarized the situation: "Our country is begging for money from the West. If someone gives us a credit for \$1 billion, we are very happy. But we could make much more money than that if we simply organized our trade in a proper way."<sup>25</sup> In this light, Western countries' reluctance to infuse large quantities of cash into Russia via aid and investment is understandable. More important for purposes of this paper is that this circumstance starkly affirms the previously cited assessment by The Economist concerning the government's inability to govern--in this case, to provide even a modicum of control over vitally important functions.

Political circumstances are not quite as dynamic in the other two major "space republics" of the FSU. However, without delving into the same level of detail, suffice it

to say that they share Russia's economic woes. For example, the Ukrainian deficit is 44 percent of the gross national product, and the country is on the brink of hyperinflation.<sup>26</sup> Like Russia, the Ukrainian economy was based on huge factories that built military products--in fact, when Krushchev once boasted that the Soviet Union could churn out rockets like sausages, he was speaking of a rocket plant in Ukraine.<sup>27</sup> Many space components continue to be manufactured there, as does the Zenit, one of the space program's more important boosters.<sup>28</sup> The political relationship with Russia is at best uneasy, at worst downright distrustful--witness the standoff over nuclear weapons and the Black Sea fleet.<sup>29</sup> Indeed, during a visit to Ukraine in September 1992, the author heard a Ukrainian colonel solicit promises of US intervention in the event of a Russian attack, and even conversations with ordinary citizens revealed a wary opinion of Russia--they seemed to prefer being associated with Europe.

Unencumbered by experiments in democracy, Kazakhstan has actually enjoyed some measure of economic success under the iron-handed rule of President Nursultan Nazarbaev. Western businesses have been attracted to its mineral wealth and a predictable (albeit centrally controlled) atmosphere for striking deals. Yet, unlike Ukraine, the country remains shackled by having retained the Russian ruble as its currency, and, hence, it suffers from all of the monetary foibles discussed above. For this and other reasons, U.S. News and World Report characterized the relationship with Russia as "ambiguous at best." To complicate matters, industrial output is down fifteen percent, Islamic fundamentalism looms on the horizon, and Kazakhstan's regional neighbors are not exactly icons of stability (Tajikistan, for example, is in the midst of a civil war).<sup>30</sup> Control of the staff at the Baikonur Cosmodrome and who pays and feeds them are a major source of difficulty between Russia and Kazakhstan, and conditions there are reportedly deteriorating as a result.<sup>31</sup>

In short, the politico-economic environment in which the FSU space program finds itself is marked by rampant inflation, growing unemployment, a desperate need

for hard currency, an industrial complex struggling to survive, tenuous relationships between the "space" governments, various internal and external sources of instability, and, at least in Russia, a government increasingly unable to govern.

#### **4. SPACE PROGRAM IN TRANSITION**

*We are not preparing to torpedo anything, not the manned programme nor scientific projects nor satellites for the national economy, nor the dual-purpose satellites necessary for the security of the state.*

**Yuri Koptev**

Head of the Russian Space Agency<sup>1</sup>

That the continued viability of the space program is important to the Commonwealth of Independent States (CIS) is beyond question: the very first agreement among the successor states, signed even before the Soviet Union dissolved, concerned the space program.<sup>2</sup> The agreement established a CIS Space Agency, the efficacy of which is subject to question since the three major space republics have each set up their own separate agencies.<sup>3</sup> The agreement also committed the signatories to "retain and develop" the rocket technology infrastructure,<sup>4</sup> the viability of which would benefit the beleaguered industrial sector significantly. Moreover, it has been said that "for any country, a viable space program is a source of pride and prestige,"<sup>5</sup> and clearly this is as true for the former Soviet republics as it was for the Soviet Union. With little else to be proud of, this dimension takes on even added weight--the Washington Post reports "a sense [in Russia] that only its nuclear and space technologies separate it from Third World status" and that there "is a growing anxiety about Russia's perceived loss of superpower status."<sup>6</sup> All of these factors combine to reflect what Marcia Smith, a veteran Soviet space program analyst with the Congressional Research Service, calls a "strong desire to keep everything going."<sup>7</sup>

Previously observed was the fact that the Soviet space program was dominated by the military, and according to Aviation Week and Space Technology, "the outlook is



for the military to continue dominating Russian space operations."<sup>8</sup> However, the Russian military appears to be nearing complete shambles: Navy recruits have recently starved to death, ships rarely steam, fighter pilots rarely fly, and the military leadership apparently had great difficulty rounding up enough sufficiently competent troops to send a 3,000 man peacekeeping force to a rebellious autonomous region.<sup>9</sup> Given the strategic importance of space assets and the legacy the Russians inherited from the Soviets on integration of space capability into warfighting strategy and doctrine, it is clear that military space projects will remain near the top of Russian priority list for funding. That such funding will be a paltry fraction of what was in the heyday of the space program almost goes without saying. Recently, Koptev himself said "Russian space activities are going through a very difficult time. These difficulties are primarily due to a significant cutback in military procurement."<sup>10</sup>

For all intents and purposes, then, the previously lavish funding for the space program has "virtually been cut off".<sup>11</sup> Resultant horror stories are rampant: ground controllers in Moscow protested low salaries with a strike<sup>12</sup>; low salaries and inhuman working conditions prompted military conscripts at the Baikonur Cosmodrome to riot<sup>13</sup>; a satellite plant was told it would be given no more metal unless it provided timber in return<sup>14</sup>; ground stations have charged other elements of the same program for services<sup>15</sup>; prices charged for components manufactured in other republics have gone up 30 to 50 times<sup>16</sup>; and "astrophysicists earn less than bus drivers."<sup>17</sup> Given the stated intention to keep the whole space program alive and the military's vested interest in seeing that happen, where is the money possibly going to come from? The Russians' scheme: "Break into the world market for space technology. . . The focus of the fund raising will be Western countries, especially the US."<sup>18</sup>

## **5. ENTERING THE INTERNATIONAL SPACE MARKET**

*[Russian] space officials have turned to the West with a vengeance, seeking to make sales, sign launch contracts, and negotiate technology licenses--anything to keep hard currency flowing into their programs.*

**Science Magazine**

June 1992<sup>1</sup>

Unlike the half-heartedness of the Soviets' efforts, the zeal with which the space program is now attempting to break into the world space market is extreme. Aviation Week and Space Technology says Yeltsin "appears ready to cut any and every deal on space that he can."<sup>2</sup> Time magazine says "virtually every branch of the space infrastructure, once financed by the Soviet military, has trade representatives in the U.S."<sup>3</sup> Apparently, everything is for sale--even "once highly classified programs are up for grabs,"<sup>4</sup> which continues the tradition started by the Soviets with their Satellite Control Center leasing scheme. The Russians have gone their predecessors one better, however--they are now even peddling once ultrasecret spy photographs taken by their most powerful spy satellites to satisfy their insatiable appetite for hard currency.<sup>5</sup> According to one source, "One general rule seems to be emerging: Money talks, and Western hard currency talks loudest of all."<sup>6</sup> Although they "are seeking to sell their products to anyone with hard currency,"<sup>7</sup> the Russians believe that "America--and to a limited extent, the West--has streets that are paved in gold"<sup>8</sup> and that we can hardly wait to snap up the space technology of which they are so proud.<sup>9</sup>

Unfortunately, there seems to be very little room in the international space market, particular in the already oversupplied area of launch vehicles and services.<sup>10</sup> There are only 30-35 commercial launches per year<sup>11</sup>--despite projections of a short-lived surge in commercial launches in 1994-95,<sup>12</sup> even winning every contract would hardly be enough to sustain an industry with a demonstrated annual launch capacity in excess of 100 launches. And, as was previously observed, launch services is where

the Russians have a clear cut advantage--similar advantage is less apparent in other endeavors, where the market is often quite small.<sup>13</sup>

Those Western companies that have signed up to deals have sometimes encountered rather bizarre problems. For example, Motorola apparently signed a contract with Krunichev Enterprise in Moscow to launch Motorola's planned Iridium communications satellite constellation on Proton rockets built by Krunichev. However, KB Salyut, another space enterprise that designed the rocket, claims it owns the engineering specifications for the Proton and anyone wanting to purchase one has to deal with them. KB Salyut says the Motorola-Krunichev deal is invalid and that no Proton can leave the plant without its blessing. Russian law does not address how to determine who owns the rights to the rocket--it was never important before. Meanwhile, hapless Motorola is caught in the middle, and as Space News put it, "this kind of dispute threatens to scare away prospective bidders for Proton launch services."<sup>14</sup>

An additional impediment to marketing the space program in the West is pricing. For example, as the result of an agreement between Yeltsin and President Bush, the Russians were allowed to bid on the launch of a US-built INMARSAT satellite.<sup>15</sup> The cost to launch the satellite on a Western booster is about \$62 million. The bid from KB Salyut through the Russian Space Agency was \$36 million,<sup>16</sup> a price that Krunichev protested as *absurdly high*.<sup>17</sup> Krunichev claims to keep accurate track of costs and that its costs are considerably lower, which may indeed be true due to very low labor costs.<sup>18</sup> It seems more probable that most Russian enterprises would have no way to accurately calculate costs,<sup>19</sup> which would hardly be surprising in a country that used to measure electronics production by weight.<sup>20</sup> But actual cost is not the issue--hard currency is.<sup>21</sup> Any hard currency income is essentially pure profit because it is cash that would not otherwise be generated. In fact, the Mir space station project is now funded largely by selling "rides" to guest astronauts from foreign countries for about \$15 million.<sup>22</sup>

The difficulty that pricing causes is that by selling launch services (or any other space product or service) at cut rates--whether or not those rates reflect real costs--the Russians threaten the very survival of Western space industries.<sup>23</sup> Thus, in the interest of preserving these space industries, Western governments are unlikely to permit unbridled competition from former Soviet republics. Indeed, the US response to all of the Russian marketing efforts has been somewhat cool--US companies and the US government tend to be interested in specific technology projects and pieces of hardware rather than large undertakings involving complete systems, the Motorola deal being a notable exception.<sup>24</sup> This has become a source of exasperation to the Russians, who cannot understand why we are not buying their "wonderful stuff."<sup>25</sup> After recently visiting Moscow, Nicholas Johnson described the situation as follows: "They were willing to sell anything that wasn't tied down. It's a lot like a flea market --there's a lot of junk, a lesser number of items that are a real bargain, and even fewer things that you really need."<sup>26</sup>

Not everyone agrees that the former Soviet space program is so desperate.<sup>27</sup> After all, the program managed at least 47 launches in 1992 (again, more than the rest of the world combined),<sup>28</sup> no programs have been cancelled,<sup>29</sup> and the U.S. has recently shown interest in the Energia heavy lifter to boost the NASA space station into orbit.<sup>30</sup> However, the number of 1992 launches (still anemic by Soviet standards) may reflect usage of leftover inventory more than it does the health of the program, and it would appear that "cancellation"--or lack thereof--has a different connotation in the former Soviet space program than it does in the US aerospace industry.<sup>31</sup> Moreover, resuscitation of Energia is hardly enough to reverse the declining fortunes of the program, references to which are common in the literature. For example, a February, 1993 Aviation Week and Space Technology article reported serious rifts between high ranking military and civilian space officials, largely over economic issues.<sup>32</sup> Thus, the author stands by the thesis that the former Soviet space program

is in dire straits and its curators are willing to "cut any deal," as someone else said, that will bring in hard cash--with, as shown below, little regard for the source.

## **6. WHERE TO TURN**

*If Russia is not allowed to enter the commercial launch market, it [will] sell its rocket technology to countries like Iraq.*

**Yuri Koptev**

to US negotiating team in Moscow

December 16, 1992

Paraphrased in Space News<sup>1</sup>

Clearly, the former Soviet "space Republics" need much more hard currency to keep their space industry afloat than they are likely to earn in America. Where else can they go? Not to Europe or Japan--they are just as likely as the US to balk at the pricing problems, legal uncertainties, shaky political relationships, and decaying infrastructure (like Baikonur) associated with the FSU space program. The only other place to turn is to the developing (or "Third") world, where the appeal of thrift can overcome these kinds of disincentives. Herein lies the danger--and the most significant impact on the US military space program. There are those that will scoff at this notion, but as has been shown, the survival of the former Soviet space program is at stake. Judging from the Herculean efforts already displayed by the Russians to hawk their wares, why should we think they will simply fold up shop when the Western countries do not sign up?

Koptev's threat seems a strong indication that the Russians, at least, have no intention of giving up. Whether this was "a slip into Soviet-style bluster"<sup>2</sup> makes little difference--actions speak louder than words. The Russians have made a deal to sell advanced liquid-fuel rocket engine technology to India's Space Agency in blatant violation of the Missile Technology Control Regime (MTCR), which is an international agreement designed to prevent the proliferation of ballistic missile technology (rocket engine technology applies equally to ballistic missiles and space boosters).<sup>3</sup> The US

State Department has imposed sanctions against Glavkosmos, the old Soviet commercial marketer that signed the deal and which is now a "private" space enterprise.<sup>4</sup> The sanctions and continuous diplomatic pressure have had no effect--the deputy director of the Russian Space Agency was recently quoted as saying "Our position is completely clear: we are cooperating with India and will continue to cooperate,"<sup>5</sup> and Yeltsin lent his support to the arrangement as well.<sup>6</sup> Even if the Russian government, such as it is, were inclined to stop such deals, it has been previously shown that its capacity to do so is questionable.

A truly devout optimist might posit a dramatic turn of events: the Russians will see the light, embrace principle over hard currency, and develop airtight control mechanisms to somehow spare themselves the embarrassment of having to sell their space products, services, and technology to the Third World just to make ends meet. Even if such an unlikely turn of events were to occur, it would only hasten what is clearly inevitable: the former Soviet space program is doomed to shrink--one projection takes it to a level of employing a mere 100,000 to 200,000 people.<sup>7</sup> Ironically, even this would have little impact on the proliferation of Soviet-developed space technology to the Third World.

The reason is captured in a simple question: What are all of the rocket scientists going to do for work? As it is, they only earn a few hundred dollars per year,<sup>8</sup> and it was previously noted that displaced engineers are having to take menial jobs. It hardly seems risky to predict that many of these technically skilled people will be willing and available to work for anyone who wants to hire them. Consider that before the Gulf War, Saddam Hussein hired a group of Brazilian scientists for \$6,500 each *per month* just to develop an Iraqi copy of the Sidewinder air-to-air missile.<sup>9</sup> Scientists, engineers, and technicians with space expertise would most surely command at least as much as experts in a 30 year old missile design. It would be difficult indeed for a Russian engineer (or anyone else, for that matter) making the

equivalent of \$10 or \$20 per month to not be tempted by such a relatively astronomical offer. Russia's dysfunctional government would be hard pressed to control the emigration of such people. So whether it is through fire sales on extant systems and services or through hiring the "know-how," Third World countries now have access to Soviet-developed space technology at prices that are well within their financial reach. It is important to note that this access is a direct result of the Soviet Union's demise--recall that until that demise had essentially become a foregone conclusion, the Soviets had only token interest in selling their space wares, and they certainly did not have today's pressure to generate cash at virtually any price.

A logical question at this point is, "So what if Third World countries have access to former Soviet (or anyone's, for that matter) space technology?" The answer requires a short digression on the military advantages that accrue from space assets.

## **7. THE IMPORTANCE OF SPACE ASSETS IN MODERN WARFARE**

*The mission of the United States Air Force is to defend the United States through the control and exploitation of air and space.*

**Mission Statement of the U.S. Air Force**  
Revised, June 1992<sup>1</sup>

The explicit mention of space in the new Air Force mission statement reflects a growing awareness of the vital contribution that can be made to the nation's defense via space. Many visionary thinkers have long grasped this notion, but it is only recent military operations such as Operation DESERT STORM that have made common knowledge--even within the US military--of the tremendous leverage and force multiplying value of space systems.<sup>2</sup> Noted author Arthur C. Clarke even went so far as to describe DESERT STORM as "the world's first satellite war,"<sup>3</sup> but the use of space systems to support terrestrial combat actually dates at least to the Vietnam war.<sup>4</sup>

The military advantages of space accrue primarily from the fact that satellites enjoy unimpeded global access--unimpeded, that is, from the standpoint of legal,

political, or sovereignty considerations (there are numerous constraints that derive from the laws of physics). The most obvious of these advantages is observation--satellites provide a "God's eye" view of the earth. One need not be a military expert to understand the tremendous advantage of being able to observe one's enemy--reconnaissance from space in support of ground combat is "the foremost example of the impact of the space age on modern warfare," notes Nicholas Johnson.<sup>5</sup> A related advantage is surveillance--using appropriate sensors and orbits, satellites can provide timely notification of such things as missile launches and nuclear detonations.

A second very important so-called "force enhancement" capability is communications--with communications satellites, it is possible, in short order, to establish communications between any two points on the globe. The only alternatives are to rely on the unwieldy and unpredictable bouncing of radio waves off of the atmosphere or on some combination of landlines, submarine cables, and microwave relays. Again, the layman can easily appreciate the military value of quickly establishing clear and secure communications from the theater of operations to the national command authorities as well as between theater headquarters and subordinate units. In fast moving modern warfare, effectiveness of this so-called "command, control, and communications network" can be the difference between victory and defeat, and according to General Colin Powell, Chairman of the Joint Chiefs of Staff, "Satellites were the single most important factor that enabled us to build [that network]" for DESERT STORM.<sup>6</sup> All communication into and out of the theater was via satellites, as was up to eighty five percent of the communication within the theater.<sup>7</sup> A significant point is that as much as twenty percent of this traffic used *commercial* satellites,<sup>8</sup> which constitute the fastest growing category of civilian satellites.<sup>9</sup>

A third important force enhancement capability is navigation--no one would question the importance of knowing one's location during combat. Besides being limited to two-dimensional information, terrestrially based navigation systems such as



LORAN suffer from inaccuracy and spotty global coverage. The United States had partially fielded the Global Positioning System (GPS) constellation of navigation satellites at the time of DESERT STORM, and its extremely accurate three dimensional information was so valuable to troops on the ground that it was not uncommon for them to overcome the shortage of receivers by taking up a collection among them to purchase additional receiving units through commercial channels.<sup>10</sup> The military significance of being able to determine location within a matter of meters encompasses the spectrum from cooks being able to rendezvous with troops in the field to aircraft finding their targets at night and in bad weather.

The subject of weather leads to a fourth important force enhancement capability. To say that meteorological information is vital to successful military operations is an understatement--Admiral Halsey's ill-fated encounter with a typhoon during World War II as well as the critical impact of weather on the timing of the Normandy invasion are but two cases in point.<sup>11</sup> It is virtually impossible to duplicate the timeliness and comprehensiveness of satellite derived weather information with strictly ground based systems. Lieutenant General Thomas S. Moorman, commander of Air Force Space Command during DESERT STORM, noted that during that conflict, "understanding the vagaries of weather became crucial to air operations" as aircraft weapons loads were optimized for weather conditions over the target.<sup>12</sup>

Finally, "Earth sensing" is emerging as one of the most critical space-based force enhancement capabilities. Actually just another form of observation using alternative sensors, it was originally undertaken for scientific purposes. It encompasses a variety of activities ranging from measuring the Earth's shape and magnetic field (which impact the accuracy of ballistic missiles) to monitoring deforestation and the health of crops (a capability that also allows camouflage to be differentiated from real vegetation).<sup>13</sup> The US Landsat and French SPOT are two examples of such satellite systems whose products are available to the general public as well as the military--

the US made extensive use of these "multi-spectral" imaging systems for purposes ranging from targeting to mapping during DESERT STORM.<sup>14</sup> General Charles A. Horner, who was the Joint Force Air Component Commander in DESERT STORM and now commands both the United States Space Command and the Air Force Space Command, has been quoted as saying "the accuracy of SPOT satellite imagery was an invaluable asset to the offensive air campaign."<sup>15</sup>

When all of these space-based force enhancement capabilities are properly integrated into military planning and operations, their impact can be decisive, as General Moorman observed about DESERT STORM: "For the first time, space systems were an integral part of terrestrial conflict and were crucial to its outcome."<sup>16</sup> This lesson was not lost on the rest of the world.<sup>17</sup>

## **8. THE PROLIFERATION OF MILITARY SPACE CAPABILITY**

*Nobody should be surprised if one day, without anything to do with the Gulf Crisis, we also sent into space a satellite with an intelligence capability.*

**Moshe Arens**

Israeli Defense Minister

to the Knesset, circa March, 1991<sup>1</sup>

Mr. Arens' threat was not an idle one--Israel has put two satellites into orbit, at least one of which was a retrograde launch (against the direction of the Earth's rotation), which is no easy feat.<sup>2</sup> So it is not a question of when space systems will proliferate to other countries--that process has long been underway. Today, fourteen nations have their own communications satellites, and five more have definitive plans for them.<sup>3</sup> India has significant space capabilities and plans to spend \$190 million this year on its space program.<sup>4</sup> China's considerable accomplishments in space are well documented, and it has entered the commercial launch market with its Long March booster.<sup>5</sup> Brazil also has an ambitious space program.<sup>6</sup> Pakistan, Indonesia, Taiwan,

and South Africa have space programs as well.<sup>7</sup> Simply put, it is widely recognized that space offers high economic leverage to any nation with the means to pursue it.<sup>8</sup>

What the Gulf War has done is to spotlight the associated security leverage of space systems and thereby kindle new interest in acquiring militarily useful space capabilities: the United Arab Emirates recently asked to buy a spy satellite from the US; South Korea and Spain have expressed similar interests;<sup>9</sup> the Europeans' interest in satellites for military purposes has also been piqued.<sup>10</sup> Such examples abound.

Those skeptical that Third World countries would enter the military space arena should bear in mind that proliferation of military space capabilities does not require dedicated military satellites--all of the force enhancement capabilities explained earlier can be purchased today on the open market. For example, Iraq used commercially available satellite photography extensively in its war with Iran and was attempting to purchase commercially available current imagery of the Middle East after it invaded Kuwait--only the UN trade embargo stymied the effort.<sup>11</sup> Perhaps in anticipation of such difficulties, Iraq launched a rocket in 1989 that it claimed was a space launch, although no satellite was orbited.<sup>12</sup> Fortunately, Iraqi launch technology advanced no further, for as one analyst put it, "The grand deception carried out by coalition forces in the recent Persian Gulf war would have been greatly complicated, if not made impossible, had Iraq possessed timely data from observation satellites."<sup>13</sup>

As previously noted, Earth sensing satellites have military utility, and, thankfully, the French limited SPOT sales during the war strictly to allies. Ironically, EOSAT--which markets images from the less capable US Landsat system--remained legally bound to openly sell Landsat imagery and was doing so as late as mid-February 1991.<sup>14</sup> Whether any of the imagery fell into Iraqi hands may never be known. In any case, Iraq did have access to imagery from US weather satellites throughout the war because the National Oceanographic and Atmospheric Administration feared the political fallout from blacking out the signal in the region--

friendly countries would have lost access as well.<sup>15</sup> The military utility of such weather information has already been noted, but more significantly, such imagery can show troop dispositions--an English college lecturer using homemade equipment to download imagery from the European Space Agency's Meteosat 4 satellite during the war was able to discern concentrations of troops.<sup>16</sup>

Hence, the genie is out of the bottle and it is impossible to put it back in.<sup>17</sup> But any country with designs on incorporating space capabilities into its military posture would be foolhardy to rely on commercial systems or systems owned by other countries because access to those systems can always be denied if the situation dictates. On the other hand, an indigenous capability to design, build, launch, and operate military space systems has, up to now, been prohibitively expensive for all but a few countries. The state of affairs in the former Soviet space program clearly changes this picture in a number of ways that are worth recounting: anything and everything is for sale at bargain prices; the space republics' governments (particularly Russia's) have dubious ability to either control such sales or control the emigration of rocket scientists that can be hired for a relative pittance; the former Soviet technology results in rugged, relatively uncomplicated yet capable equipment suitable for operation by underdeveloped countries; and, as the failure of the MTCR to stop the transfer of rocket technology to India shows, international controls on arms and technology transfers are ineffective in stopping this technology hemorrhage.

## **9. IMPACT ON THE US MILITARY SPACE PROGRAM**

*We have four mutually supportive goals that guide our overall national security efforts.. [Among them is] ensuring that no hostile power is able to dominate or control a region critical to our interests.*

**National Security Strategy of the United States**  
January, 1993<sup>1</sup>

*The threat is instability and being unprepared to handle a crisis or war that no one predicted or expected. . . . It is certain that US*

*military forces will be called upon again, but predicting the time, place, and circumstances will be difficult . . . As the only nation with military capability to influence events globally, we must remain capable of responding effectively.*

**National Military Strategy**

1992<sup>2</sup>

As with all other aspects of our military force structure, our space force structure must be grounded in the National Security Strategy and the supporting National Military Strategy. What is clear from the excerpts above is that these strategies no longer focus on a specific threat in the fashion that their predecessors focused on the Soviets. Unspecified, unpredictable "regional threats" are the adversaries against which we must be capable of victoriously employing military forces.

To the many who dream of "de-militarizing space", this shift of threats means "an opportune time to signal a change of emphasis from military to civil space activity is right now," as one writer suggested when the Soviet bloc began to crumble.<sup>3</sup> To others such as members of the United States Congress, the problem is economically driven--the 1993 Defense Authorization Bill mandates a 15 percent cut in the military space budget. The Senate proposed an even larger 25 percent cut.<sup>4</sup> After all, if we were in a "space race" against the Soviets and they dropped out, it only seems logical to stop wasting money on sending military systems into space, which by international treaty is supposed to be used only for peaceful purposes anyway. The evidence presented in this paper leads to two major conclusions that fly in the face of both of these understandable but misguided reactions:

***FIRST: There is no "Peace Dividend" in Space.*** Contrary to the implication of all the "space race" rhetoric over the years, our military activities in space after the initial flap over Sputnik were not really driven by the Soviet military space program,<sup>5</sup> with one exception--the Soviet anti-satellite or ASAT program. In other words, unlike terrestrial forces, our space forces were not "sized" to counter or match similar Soviet space forces. Rather, the assets we placed in space were there for

the kinds of force enhancement purposes discussed earlier, all of which were first pursued by the United States rather than the Soviets.<sup>6</sup> Thus, the fact that there may be a decline in *space* activity, per se, on the part of the FSU has no bearing on our own military space program.

However, it is logical to suggest that since our space systems largely support our terrestrial forces, a reduced terrestrial threat should translate to a reduced number of space-based systems to enhance those forces. This is also incorrect, for the space force structure is driven far more by the functions space systems perform than by the size of any potential threat. For example, physics determines the number of satellites in a constellation required to continuously observe the surface of the earth at a given altitude, and, similarly, the number of satellites needed for global tactical weather support is independent of the size and number of potential adversaries. On the other hand, to the extent that the previous national strategy may have resulted in surveillance and reconnaissance satellite constellations optimized to observe the territory of the Soviet Union, the new strategy's focus on unspecified regional threats around the globe may actually argue for more such satellites on orbit.

In the case of military communications satellites, however, an argument could be made that the demise of the Soviet Union means fewer are needed. Such an argument would be thinly based on the idea that a smaller terrestrial force structure should require fewer communications channels. But experience does not support this thesis--the fact that augmenting commercial capacity had to be acquired during DESERT STORM reinforces General Moorman's observation on the subject:

"Communications capacity and channel availability have historically been shortfalls in conflict."<sup>7</sup> As previously observed, space-based assets offer the only practical solution to rapidly establishing communications between far flung corners of the world--precisely the problem our forces are likely to face. Command, control and

communications are so vital to modern warfare that it is clearly a false economy to try to shortchange assets like communications satellites.

Only in the context of nuclear warfighting can a case be made for scaling back our space force posture as a result of the demise of the Soviet military threat. Most observers agree with the statement in the National Security Strategy that says "the threat of thermonuclear war has been radically reduced."<sup>8</sup> Accordingly, the need for communications satellites that can survive a nuclear attack--which can cost as much as a billion dollars each<sup>9</sup>--diminishes as the threat of all out nuclear war subsides. The Air Force has recognized this fact by scaling down the incorporation of such features into the new MILSTAR satellite program and placing more tactically oriented capabilities on the space vehicle.<sup>10</sup>

Thus, contrary to intuition, neither reduced military space activity by the FSU space republics nor a reduced military threat from FSU states in the aftermath of the Soviet Union's demise argue for any significant reductions in US space force structure. If anything, the new strategy's requirement to deal with threats that may appear anywhere on the globe at any time would mitigate for more robustness in nearly all of our space-based force enhancement capabilities. Hence, the logic that suggests a "peace dividend" in space analogous to that realizable for terrestrial forces does not withstand scrutiny. But yet to be addressed are the far more severe implications of the principal consequence of the Soviet space program's demise--namely, accelerated proliferation of space technology, which leads to the second major conclusion.

***Second: It is time to get serious about Space Control.*** A large portion of this paper has been devoted to providing evidence that as a result of the Soviet Union's demise and the economic woes left in its wake, even countries with modest means are in a position to avail themselves of space technology from the FSU, either in the form of actual systems and/or services, or in the form of expertise. It must be assumed that within that group of countries are some or all of the unspecified

potential adversaries that our military strategy identifies as our principal threat. This paper has also presented evidence that, largely as a result of the critical role played by space systems in DESERT STORM, there is a growing realization in the world of the tremendous military leverage space systems offer. Again, it must be assumed that our potential adversaries are party to this revelation. It follows, then, that we must prepare for the fact that, unlike Iraq in DESERT STORM, our adversaries in future conflicts will employ against us the military advantages of space systems upon which the success of our own forces has become so dependent.

It can be argued that the more budget cuts shrink our combat forces while our strategy calls for prevailing over globally dispersed threats, the greater becomes our already considerable dependence on space based systems--possibly bringing it to the point of becoming what Clausewitz defined as a center of gravity: "the hub of all power and movement, on which everything depends."<sup>11</sup> One need only ponder for a moment the consequences of losing some or all of our space-based communications, observation, navigation and meteorological capabilities to realize the value to an enemy of eliminating or neutralizing those systems. On the other side of the same coin, however, lies the fact that eliminating or neutralizing an enemy's space-based force enhancement capabilities would be of great value to us. The obvious thing to do in the event of hostilities is to deny the enemy the benefits of his space-based systems while preserving those of our own.

The mission area concerned with this double-edged problem--"space control"--has long been recognized as a necessary tenet of military space doctrine. Serious efforts to control access to space date at least to the US deployment in the 1960's of a nuclear tipped ASAT system as a defense against a Soviet fractional orbit bombardment system.<sup>12</sup> In 1968, the Soviets first tested a co-orbital ASAT system capable of destroying satellites in orbits as high as 5,000 kilometers (the system's current viability is subject to debate).<sup>13</sup> In response, the US attempted in the mid-1980's to



field a more technologically advanced system with comparable capabilities.<sup>14</sup> That system was cancelled by Congress after becoming bogged down in debates over all manner of things ranging from who depended more on space to the idealistic anathema of crossing the "Rubicon of active weapons in space."<sup>15</sup> Often emotional, the arguments against deployment of the system varied between this latter idealistic vein and the arcane application of arms control and nuclear deterrence theories to the dual premise that US interference with Soviet satellites would somehow be destabilizing while Soviet attacks on US satellites with their ASAT would be harmless.<sup>16</sup>

Throughout the Cold War, many forward thinking writers argued and pleaded for pursuit of the space control mission area.<sup>17</sup> There was recognition of the need at the highest levels: the National Security Strategy of 1987 called for "unimpeded US access to the oceans and space."<sup>18</sup> In 1989, General Piotrowski published a list of six major initiatives that should be pursued to overcome space control deficiencies that he attributed to "an attitude which persists in the US . . . which seems to reject the military utility and necessity of space operations."<sup>19</sup> Yet, despite the valiant attempts of these and many other space-conscious strategic thinkers to prevent the emerging center of gravity represented by our space force structure from becoming a potentially fatal vulnerability, and despite the new Air Force mission statement's explicit mandate to control space, it is not clear to this writer that very much has been done to seriously pursue space control capabilities.

We must leave behind the Cold War mentality and revisit the space control issue if we are to fulfill the mandate of the new Air Force mission statement--what matters today is that we are required by our strategy to be capable of engaging in conventional warfare against a multiplicity of threats potentially equipped with space-based force enhancement capabilities. Arguments about who would depend more on space systems or whether, in the interest of preserving the sanctity of space, potential foes would refrain from attacking our space systems are completely moot--try to

imagine Saddam Hussein pondering these kinds of thoughts. Through blatant violations of the Nuclear Non-proliferation Treaty, Iraq and North Korea have both shown that determined belligerents consider themselves to be unconstrained even by arms control agreements to which they are a party, let alone esoteric arguments over the "militarization" of space. If one of these types of "regional threats" becomes our enemy, the control of space could be a critical if not decisive factor in determining the outcome of the conflict.

There are two key facets of achieving space control--the first is invulnerability to space countermeasures. It is not always necessary to attack the space segment of a force enhancement system to temporarily or permanently deny its use to its owner. A terrorist attack on a satellite ground station somewhere in the world could just as easily deny or inhibit the use of a satellite system. Similar countermeasures run the gamut from camouflage, concealment and deception (CCD) to "spoofing" a satellite's command signals to electronically jamming a satellite's transmissions. With the availability of "know how" from the FSU, all of these are now potentially (if not actually)<sup>20</sup> within the means of our potential regional adversaries. Even a crude ASAT in the hands of a regional power is conceivable--after all, it was not that long after Sputnik that the Soviets developed their ASAT. It stands to reason that measures to neutralize space countermeasures would be kept secret to preserve their effectiveness, so it is impossible to glean from the public record everything that might be underway to reduce our vulnerabilities. What can be said is that because execution of our military strategy has become so reliant on space systems, the ability to retain the use and benefits of those systems must be vigorously pursued. One initiative appearing to need serious attention is replacement of overseas ground stations with relay satellites. Another is to once and for all solve the problem of access to space--the well documented deficiencies in our launch vehicle force severely inhibit our ability to replace satellites that are disabled either by deliberate attack or by chance.<sup>21</sup>

The second facet of space control is to acquire the means to negate the space capabilities that our future adversaries might employ against us. Obviously, we have the capability to attack ground stations and one would presume that we have pursued means of jamming and spoofing satellites. However, it is not clear to this writer, for example, that CCD in the context of a regional enemy with access to space systems has received adequate emphasis in the doctrine and training of our combat forces. Further, DESERT STORM suggests that there is some work to be done regarding denial of information from friendly space systems to an enemy. And, notwithstanding all of the emotional arguments on both sides of the ASAT issue, the fact remains that we have no ASAT with which to negate the space segment of an enemy's space system should all other means fail. As General Moorman put it, "An operational ASAT designed to eliminate an adversary's space capabilities must be considered an integral part of this country's force structure."<sup>22</sup>

The old paradigm that abhors this so-called "militarization" of space has transcended the innocence of naivete--such thinking truly endangers our national security in the post-Soviet environment of rapid space technology proliferation. Space was "militarized" long ago--even civil systems have tremendous military utility, and there is nothing in the Outer Space Treaty that prohibits conducting the kind of force enhancement activities that have been discussed.<sup>23</sup> A far more significant concern for the nation should be the danger that our space force posture will be driven by arbitrary budget cuts rather than sound analysis of national and military strategy in the context of the evolving world environment.

## **10. SUMMARY**

In sum, the perilous economic situation in the Soviet Union's aftermath has put its once proud space program in dire straits, prompting a desperate attempt to keep the program whole via entry into the Western commercial space market. With little potential for this market to sustain the FSU program intact, selling space products,

services and technology to the developing world is the only alternative. Even if so inclined, the space republics have little ability to control either the hemorrhage of space technology to the Third World or the inevitable "brain drain" of former Soviet scientists. The result is an unavoidable acceleration of the proliferation of space technology to nations in the Third World, who--like all nations--have been awakened by DESERT STORM to the tremendous military advantages that accrue from space.

What the Gulf War also exposed is how much we have come to depend on space systems. As the budget shrinks our combat forces, this dependence begins to take on the character of a center of gravity. Thus, contrary to intuition, the Soviets' demise yields no peace dividend in space--we must maintain and improve our existing space force structure to support our strategy of defending US interests against unspecified regional threats that are globally dispersed. Moreover, as space technology proliferates to these potential threats, we become subject to employment of space based force enhancement capabilities against us as well as to the loss of our own space based force enhancement assets--during a conflict, either could render a crippling blow. If both occurred together, the result could be devastating. Therefore, it is imperative for the United States to vigorously pursue any and all technologies that will provide the capability for space control, both in the sense of preventing an enemy from denying us the use of our space assets and in the sense of denying him the use of his own space-based force enhancement assets--the accelerated proliferation of which is the most significant impact of the Soviet Union's demise on the US military space program.

## NOTES

### Section 1 (pages 1-2)

1. Quoted in Alasdair McLean, *The Military Use of Space*, CENTERPIECE Number 19 (Aberdeen, Scotland: Centre for Defence Studies, Summer 1991), 5.

2. Nicholas L. Johnson, *Soviet Military Strategy in Space*, (New York: Jane's Publishing, Inc., 1987), 20 (information on nature of Sputnik); Mclean, 4 (information on announced Soviet intentions to launch a satellite).

3. Marcia S. Smith, *Space Activities of the United States and Other Launching Countries/Organizations: 1957-1991*, CRS Report for Congress No. 92-427 SPR (Washington D.C.: The Library of Congress, Congressional Research Service, May 11 1992), 82.

4. Ibid., 91.

### Section 2 (pages 2-5)

1. Nicholas L. Johnson, *Soviet Military Strategy in Space*, (New York: Jane's Publishing, Inc., 1987), 18.

2. Michael D. Lemonik, "Space Program for Sale," *Time*, 16 March 1992, 54.

3. Statement of Roald Sagdeev to the American Astronautical Society, paraphrased in Leonard David, "Boosters versus Bread Lines," *Ad Astra*, July/August 1992, 6.

4. Tom Cremins and Elizabeth Newton, "Changing Structure of the Soviet Space Programme," *Space Policy*, May 1991, 129.

5. Craig Covault, "Russian/CIS Space Outlook Chaotic But Critical to Global Planning," *Aviation Week and Space Technology*, 16 March 1992, 125.

6. Vice President's Space Policy Advisory Board, *The Future of the U.S. Space Industrial Base--A Task Group Report*, (Washington, D.C.: The White House, November 1992), 20.

7. Marcia S. Smith, *Prospects for the Post Soviet Space Program*, CRS Report for Congress No. 92-123 SPR (Washington D.C.: The Library of Congress, Congressional Research Service, 4 February 1992), 4.

8. John L. Piotrowski, "A Critical Juncture," *The Officer*, September 1989, 21.

9. Marcia S. Smith, *Space Activities of the United States and Other Launching Countries/Organizations: 1957-1991*, CRS Report for Congress No. 92-427 SPR (Washington D.C.: The Library of Congress, Congressional Research Service, May 11 1992), 12.

10. Lemonick, 55.

11. Cremins, 129-130; Piotrowski, 20.

12. Sagdeev, 6.

13. Johnson, 48.

14. Ibid., 49-50.

15. Piotrowski, 21.

16. Johnson, 85.

17. Ibid., 191.

18. Secretary Aldridge: "Space is viewed by the Soviets as a 'no holds barred' environment and they view 'space power' as essential to ultimate military victory and the subsequent success of the USSR." Quoted in Johnson, 159; Secretary Weinberger: "The Kremlin appears to have focused its space effort to support and conduct combat operations." Quoted in Piotrowski, 22.

19. Department of Defense, *Military Forces in Transition*, (Washington, D.C., Department of Defense, 1991), 42.

20. Sagdeev, 6.

21. Cremins, 135.

22. Ibid., 129.

23. Vera Rich, "Soviet Space Saver," *New Scientist*, 14 March 1992, 13.

24. Cremins, 130.

25. Craig Covault, "Soviet Military Space Center Offered for Commercial Lease," *Aviation Week and Space Technology*, 16 September 1991, 28.

26. Smith, Prospects for Post Soviet Space Program, 3-4.

27. Johnson, 79-82.

### **Section 3 (pages 6-10)**

1. Tom Brokaw, *NBC Nightly News*, 29 March 1993.

2. Dimitri Simes, "What Clinton Must Do To Aid Democracy in Russia," *The Washington Post National Weekly Edition*, 8-14 February 1993, 24.

3. "Gloom, not doom," *The Economist*, 28 November 1992, 16.

4. In order cited:

Sergei Krushev, "Capitalism and Chaos: Russia's Next Implosion," *The Washington Post*, 16 August 1992, C7.

Steve Coll and Michael Dobbs, "From Russia With Cash," *The Washington Post National Weekly Edition*, 15-21 February 1993, 6.

Peter A. Fischer, Director, Carnegie Endowment Moscow Office, quoted in Fred Hiatt, "Bailing Out Russia," *The Washington Post National Weekly Edition*, 15-21 March 1993, 8.

Fred Coleman, et al, "Deja vu all over again," *U.S. News and World Report*, 8 March 1993, 39.

5. Douglas Stanglin and Victoria Pope, et al, "The Wreck of Russia," *U.S. News and World Report*, 7 December 1992, 40.

6. Hiatt, 9.

7. Ibid.

8. Ibid.

9. Douglas Stanglin and Victoria Pope, "Two cheers for demokratiya," *U.S. News and World Report*, 5 April 1993, 46.

10. Hiatt, 9.
11. Intourist Guide on author's visit to Moscow, September 1992.
12. Julie Corwin and Jeff Trimble, "Russia's Swords and Plowshares," *U.S. News and World Report*, 18 January 1993, 54.
13. Sales in 1992 were 70 percent below those of the Soviet Union before its collapse, according to Gennady Yampolsky, Deputy Chairman of the State Committee on the Military-Industrial Complex, paraphrased in "Russian Arms Trade," *The Washington Post*, 23 February 1993, A4..
14. Craig Covault, "Russians Forge Space Pact, But Military Transition Chaotic," *Aviation Week and Space Technology*, 13 January 1992, 20.
15. Corwin, 54.
16. Ibid., 55; Sagdeev, 6.
17. Corwin, 55; Keith Bradsher, "Anxiety Slows Borrowing by Russia," *New York Times*, 29 September 1992.
18. Corwin, 54; "Mass Appeal," *The Economist*, 29 August 92, 16.
19. Keith Bush, "An Overview of the Russian Economy," *RFE/RL Research Report*, 1:25 (19 June 92), 51.
20. "Mass Appeal," *The Economist*, 29 August 1992, 16; Jeffrey D. Sachs, "It's Time for the West to Put Up," *The Washington Post National Weekly Edition*, 5-11 April 1993, 24.
21. CNN, "Headline News," 20 January 1993, 4:30 P.M.
22. Stanglin, *Wreck of Russia*, 44.
23. All information since previous note taken from Sergei Zhdakayev, "A Job No Longer Lasts Forever," *Isvestia* in *World Press Review*, November 1992, 11-12.
24. Coll, *From Russia With Cash*, 6-7.
25. Steve Coll and Michael Dobbs, "The Free Market's Ugly Face," *The Washington Post National Weekly Edition*, 1-7 March 1993, 10.



26. Chrystia Freeland, "Ukraine Facing Economic Shifts," *The Washington Post*, 1 January 1993, A 23; Simon Johnson and Oleg Ustenko, "Ukraine on the Brink of Hyperinflation," *RFE/RL Research Report*, 1:50 (18 December 1992), 52.

27. Freeland, A23.

28. Craig Covault, "Russian/CIS Space Outlook Chaotic but Critical to Global Planning," *Aviation Week and Space Technology*, 16 March 92, 125; Craig Covault, "Russians Rejuvenate Military Space Assets," *Aviation Week and Space Technology*, 4 January 1993, 54.

29. Adrian Karatnycky, "The Ukrainian Factor," *Foreign Affairs* Summer 1992, pp 90-107, reprinted in International Security Studies--WS 635: Book 1, (Maxwell Air Force Base Alabama: Air War College, March 1993), 66, 68.

30. All of the information in the paragraph up to the point of this note is from Victoria Pope, "Back to the Future in Central Asia," *U.S. News and World Report*, 8 March 93, 42-44.

31. Covault, Russian CIS Space Outlook, 127; Craig Covault, "Russians Locked in Struggle for Space Program Control," *Aviation Week and Space Technology*, 1 February 1993, 57; "Baikonur Gets Bad Publicity," *Space News*, 16-22 November 1992, 1.

#### **Section 4 (pages 10-11)**

1. Rich Vera, "Soviet Space Saver," *New Scientist*, 14 March 92, 13.

2. Craig Covault, "Russians Forge Space Pact, But Military Transition Chaotic," *Aviation Week and Space Technology*, 13 January 1992, 20.

3. Craig Covault, "Russian/CIS Space Outlook Chaotic, But Critical to Global Planning," *Aviation Week and Space Technology*, 16 March 1992, 125.

4. Marcia S. Smith, *Prospects for the Post Soviet Space Program*, CRS Report for Congress No. 92-123 SPR (Washington D.C.: The Library of Congress, Congressional Research Service, 4 February 1992), 6.

5. Tom Cremins and Elizabeth Newton, "Changing Structure of the Soviet Space Programme," *Space Policy*, May 1991, 129.

6. Fred Hiatt, "Russians Favoring Retention of Nuclear Weapons," *The Washington Post*, 13 November 1992, A1.
7. Marcia S. Smith, Congressional Research Service, interview with "Newsmaker Forum," *Space News*, 23-29 November 1992, 22.
8. Covault, Russian/CIS Space Outlook, 125.
9. Fred Hiatt, "If Yeltsin Falls, Will the Cold War Rise From the Ashes?" *The Washington Post National Weekly Edition*, 29 March-4 April 1993, 16; Bruce B. Auster, et al, "The armed forces: How they line up," *U.S. News and World Report*, 5 April 1993, 48.
10. Bruce A. Smith, "Russians May Boost Civil Space Funding," *Aviation Week and Space Technology*, 14/21 December 1992, 54.
11. Vera, 13.
12. Michael D. Lemonick, "Space Program for Sale," *Time*, 16 March 1992, 55.
13. Ibid., 55; Craig Covault, "Russians Locked in Struggle For Space Program Control," *Aviation Week and Space Technology*, 1 February 1993, 57.
14. Vera, 13.
15. Craig Covault, "Russia Seeks Joint Space Test to Build Military Cooperation," *Aviation Week and Space Technology*, 9 March 1992, 18.
16. Michael A. Dornheim, "France and Germany Will Help Fund Russian Mars 1994 Space Mission," *Aviation Week and Space Technology*, 25 May 1992, 79.
17. Peter Aldhous, "Russian Space Science Limpes On," *Science* 256 (12 June 1992): 1508.
18. Vera, 13.

#### **Section 5 (pages 12-15)**

1. David P. Hamilton, "Skeptics Pour Cold Water On a Russian 'Fire Sale,'" *Science* 256 (12 June 1992): 1510.

2. James R. Asker, "U.S., Russian Space Pact Pledges Unprecedented Trade, Joint Flights," *Aviation Week and Space Technology*, 22 June 1992, 24.
3. Michael D. Lemonick, "Space Program for Sale," *Time*, 16 March 1992, 55.
4. Tom Cremins and Elizabeth Newton, "Changing Structure of the Soviet Space Programme," *Space Policy*, May 1991, 131.
5. William J. Broad, "Russia is Now Selling Spy Photos from Space," *The New York Times* 4 October 1992, 10L; To satisfy need for hard currency taken from Daniel J. Marcus, "Firms Stretch Dollars in Russia," *Space News* 23-29 November 1992, 4.
6. Peter Aldhous, "Russian Space Science Limpes On," *Science* 256 (12 June 1992): 1509.
7. Carole A. Shifrin, "Geopolitical Changes Spark New Strategies," *Aviation Week and Space Technology*, 7 September 1992, 54.
8. Marcia S. Smith, Congressional Research Service, interview with "Newsmaker Forum," *Space News* 23-29 November 1992, 22.
9. Marcia S. Smith, *Russia/U.S. Space Interaction: A Trip Report with Observations and Options*, CRS Report for Congress No. 92-774 SPR (Washington D.C.: The Library of Congress, Congressional Research Service, 27 October 1992), 2.
10. Peter B. de Selding, "Low-Cost Proton Purchase Confirms Competitor's Fears," *Space News* 16-22 November 1992, 29.
11. Vice President's Space Policy Advisory Board, *The Future of the U.S. Space Industrial Base--A Task Group Report*, (Washington, D.C.: The White House, November 1992), 13.
12. Patrick Seitz, "Short, Sharp Increase in Launch Activity Expected in 1995," *Space News* 15-21 March 1993, 18.
13. Consider, for example, the seemingly hopeless case of six different enterprises that are attempting to crack the market for returnable capsules for space experiments--the worldwide market, which is adequately supplied, is about three or four per year. One of the capsules in work has a payload in excess of a ton, far greater than the market demand of less than a thousand pounds for all three or four of the payloads combined. A recent marketing meeting in France failed to attract any representatives from one of the principal sectors of potential customers (pharmaceutical and medical companies), despite invitations. This according to Peter

B. de Selding, "Plethora of Russian Capsules to Become Available," *Space News* 30 November-6 December 1992, 24.

14. All information on Krunichev-Motorola contract taken from Peter B. deSelding, "Krunichev, Salyut Rivalry Threatens Proton Marketing," *Space News* 15-21 March 1993, 1.

15. James R. Asker, "U.S., Russian SPace Pact Pledges Unprecedented Trade, Joint Flights," *Aviation Week and Space Technology*, 22 June 1992, 24.

16. Both prices taken from de Selding, Low-cost Proton Purchase, 3.

17. Marcia S. Smith, Congressional Research Service, personal interview with author in Washington, D.C., 22 December 1992.

18. Ibid.

19. James Oberg, "PSST! Wanna buy a Spaceship?" *Omni* 14 (January 1992): 12.

20. Esther Dyson, "Just-so stories, or plain tales from Russia," *Forbes* 14 September 1992, 366.

21. Cremins, 131.

22. Hamilton, 1510.

23. de Selding, Low-cost Proton Purchase, 3.

24. David P. Hamilton, "In Space Technology, Small May Be Beautiful," *Science* 256 (12 June 1992): 1510; Craig Covault, "U.S., Europe, Japan Vie For Russian High Technology," *Aviation Week and Space Technology*, 27 January 1992, 37; Smith, Newsmaker Forum, 22.

25. Smith, Newsmaker Forum, 22.

26. Nicholas Johnson, quoted in Hamilton, Small May Be Beautiful, 1510.

27. For example, Marcia S. Smith of the Congressional Research Service, a veteran analyst of the Soviet space program, visited Russia in September 1992 and came away with the impression that the former Soviet program is "doing quite well, all things considered." However, she does acknowledge that the program is not "as strong as it was five years ago" and she is not sure it is possible to keep the whole

thing going. She related all of this in the previously cited interview with Newsmaker Forum.

28. Craig Covault, "Russians Rejuvenate Military Space Assets," *Aviation Week and Space Technology*, 4 January 1993, 54.

29. Marcia S. Smith, Newmaker Forum, 22. Ms. Smith cited the lack of cancellations as an indicator of the relative health of the FSU space program.

30. William J. Broad, "U.S., To Cut Costs, Seeks Russian Role in Space Station," *The New York Times* 7 April 1993, A1.

31. On his own trip to Russia in September 1992, the author had the opportunity to visit the Central Aerohydrodynamics Institute near Moscow, where virtually all Soviet advanced aircraft design work and wind tunnel testing took place. Among its projects was the former Soviet space shuttle, and the opportunity was presented to visit a large thermal/vacuum chamber in which shuttle components were tested. The facility appeared disused, and although a redesigned shuttle nose section was installed on a testing jig in the chamber, the level of dust gathered on it belied the fact that no work had been done on it in quite some time. An official briefed that all funds for space shuttle work at the institute had been cut off. But he did not say the project was canceled and there was no indication they were attempting to dismantle anything. Based on this admittedly limited evidence, it would appear to the author that unlike the West where contractors immediately dismantle a project when funding is curtailed, the Russians can simply let a project go into a state of "suspended animation"--just leave it where it sits until the money starts to flow again. After all, what other project would be waiting at the gate to use the facilities? This view is supported by a recent interview with two Russian cosmonauts undergoing training for a flight on the U.S. space shuttle. Commenting on the redesign forced upon the space station project by budget cuts, one of them said, "I think our way in this case is better. In case of economic difficulties, we just move the date of a launch, but we do not change the idea." Quoted in William Harwood, "Cosmonauts Tout Strength of Russian Space," *Space News*, 15-21 March 1993.

32. Craig Covault, "Russians Locked in Struggle For Space Program Control," *Aviation Week and Space Technology*, 1 February 1993, 57.

## **Section 6 (pages 15-17)**

1. Paraphrased in Andrew Lawler, "Proton Partnership Sparks Political Furor," *Space News*, 4-10 January 1993, 1.

2. Ibid.

3. K. S. Jayaraman, "US leans on Russia to drop rocket agreement," *Nature* 356 (30 April 1992): 732.

4. Andrew Lawler, "U.S. Pressures Russia to End Deal with India," *Space News*, 15-21 March 1993.

5. Quoted in Ibid.

6. Craig Covault, "Russians Rejuvenate Military Space Assets," *Aviation Week and Space Technology*, 4 January 1993, 59.

7. Vice President's Space Policy Advisory Board, *The Future of the U.S. Space Industrial Base--A Task Group Report* (Washington, D.C.: The White House, November 1992), 20.

8. Dan Charles, "Bargain Hunters Snap Up Russian Brainpower," *New Scientist* 14 March 1992, 13.

9. "Iraq Reportedly Hires Rocket Scientists," *Jornal Do Brasil*, 31 July 1990, 3.

## **Section 7 (pages 17-20)**

1. New Air Force mission statement proclaimed by General Merrill McPeak, Chief of Staff, United States Air Force, to a gathering of senior officers at Maxwell Air Force Base, June, 1992.

2. Early observations on the military potential of space, including references to the initial 1946 Rand study on the subject and a 1958 Resolution of the House of Representatives, cited in Alasdair McLean, *The Military Use of Space*, CENTERPIECE Number 19 (Aberdeen, Scotland: Centre for Defence Studies, Summer 1991), 4-6. See also Nicholas L. Johnson, *Soviet Military Strategy in Space*, (New York: Jane's Publishing, Inc., 1987): 8,423. For more recent comments, see also:

Colonel Robert B. Giffen, *US Space System Survivability*, (Washington, D.C.: National Defense University Press, 1982), 2.

Patricia Gilmartin, "Gulf War Rekindles U.S. Debate on Protecting Space System Data," *Aviation Week and Space Technology*, 29 April 1991, 55.

John M. Collins, *Military Space Forces* (Washington, D.C.: Pergamon-Brassey's, 1989), 44.

Alasdair McLean, *Western European Military Space Policy* (Brookfield, Vermont: Dartmouth Publishing Company, Ltd (Ashgate Publishing Company in US), 1992), 145.

General Merrill McPeak, interview with "Newsmaker Forum," *Space News* 15-21 February 1993.

3. Quoted in John Burgess, "Satellites' Gaze Provides New Look at War," *The Washington Post*, 19 February 1991, A13.

4. McLean, *Military Utility of Space*, 22.

5. Johnson, 89.

6. Quoted in James W. Canan, "A Watershed in Space," *Air Force Magazine*, August 1991, 34.

7. Lieutenant General Thomas S. Moorman, quoted in James W. Canan, "A Watershed in Space," *Air Force Magazine*, August 1991, 34.

8. Sheila Galatowitsch, "Squeezing the Most Out of Space," *Defense Electronics*, January 1993, 51.

9. Patrick Seitz, "Short, Sharp Increase in Launch Activity Expected in 1995," *Space News*, 15-21 March 1993, 18.

10. James W. Canan, "A Watershed in Space," *Air Force Magazine*, August 1991, 35.

11. "The Military's Use of Space Based Systems," *Signal*, March 1986, 47.

12. Quoted in Canan, 36.

13. McLean, *Military Utility of Space*, 15,23.

14. Craig Covault, "USAF Urges Greater Use of Spot Based on Gulf War Experience," *Aviation Week and Space Technology*, 13 July 1992, 63.

15. Quoted in *Ibid.*, 63-64.

16. Quoted in Canan, 32.

17. Gilmartin, 55.

## **Section 8 (pages 20-22)**

1. Quoted in "Mission Control," *Military Space* 8:5 (11 March 1991): 1.
2. Marcia S. Smith, *Space Activities of the United States and Other Launching Countries/Organizations: 1957-1991*, CRS Report for Congress No. 92-427 SPR (Washington D.C.: The Library of Congress, Congressional Research Service, May 11 1992), 141.
3. Thomas G. Mahnken, "Why Third World Space Systems Matter," *Orbis* Fall 1991, 566.
4. Ibid., 571-572; Mike Raghuvanshi, "India's Civil Space Budget Gets 14 Percent Increase," *Space News* 15-21 March 1993, 7.
5. Smith, *Space Activities*, 121-126.
6. Mahnken, 570.
7. Ibid., 573.
8. Vice President's Space Policy Advisory Board, *The Future of the U.S. Space Industrial Base--A Task Group Report* (Washington, D.C.: The White House, November 1992), 21.
9. Vincent Kiernan and Andrew Lawler, "Emirates Want to Buy U.S. Spy Satellites," *Space News* 16-22 November 1992, 1.
10. Michael Mecham, "Gulf War Rekindles European Interest in Developing Military Satellites," *Aviation Week and Space Technology*, 8 April 1991, 59.
11. Mahnken, 568.
12. Smith, *Space Activities*, 119.
13. Mahnken, 577.
14. John Burgess, "Satellites' Gaze Provides New Look at War," *The Washington Post*, 19 February 1991, A13.



15. "Iraqi's Still Receive Weather Data From U.S. Satellites," *Aviation Week and Space Technology*, 21 January 1991, 26.

16. Alasdair McLean, *Western European Military Space Policy*, (Brookfield, Vermont: Dartmouth Publishing Company, Ltd (Ashgate Publishing Company in US), 1992), 101.

17. "Genie" concept taken from Nicholas L. Johnson, *Soviet Military Strategy in Space*, (New York: Jane's Publishing, Inc., 1987), 16.

### **Section 9 (pages 22-29)**

1. *National Security Strategy of The United States* (Washington, D.C.: The White House, January 1993), 3.

2. *National Military Strategy 1992* (Washington, D.C.: Joint Chiefs of Staff, 1992), 4.

3. Jeff Kingwell, "The militarization of space," *Space Policy*, May 1990, 111.

4. Marcia S. Smith, *Military Space Programs in a Changing Environment: Issues for the 103d Congress* CRS Report for Congress No. 92-879 SPR (Washington D.C.: The Library of Congress, Congressional Research Service, 1 December 1992), 3.

5. Nicholas L. Johnson, *Soviet Military Strategy in Space*, (New York: Jane's Publishing, Inc., 1987), 32-33.

6. Ibid., 20-21.

7. Thomas S. Moorman, "Space: A New Strategic Frontier," *Air Power Journal* 6:1 (Spring 1992), reprinted in *Military Studies Course--MS 610: Book 3* pp 211-215 (Maxwell Air Force Base, Alabama: Air War College, 1992), 213.

8. *National Security Strategy of The United States* (Washington, D.C.: The White House, January 1993), i.

9. James W. Canan, "Space Gets Down to Earth," *Air Force Magazine*, August 1990, 185.

10. James W. Canan, "A Watershed in Space," *Air Force Magazine*, August 1991, 37.

11. Carl von Clausewitz, *On War*, ed. and trans. Michael Howard and Peter Paret (Princeton, N.J.: Princeton University Press, 1976), 595-596.

12. Marcia S. Smith, *Space Activities of the United States and Other Launching Countries/Organizations: 1957-1991*, CRS Report for Congress No. 92-427 SPR (Washington D.C.: The Library of Congress, Congressional Research Service, May 11 1992), 85.

13. Johnson, 155, 186; Smith, *Space Activities*, 86.

14. The Aspen Strategy Group, *Anti-Satellite Weapons and U.S. Military Space Policy*, (Lanham, Maryland: University Press of America, 1986), 12.

15. Alasdair McLean, *The Military Use of Space*, CENTERPIECE Number 19 (Aberdeen, Scotland: Centre for Defence Studies, Summer 1991), 43. Although not associated directly with the debate, this phrase captures the mentality of those opposed to weapons of any kind in space.

16. To get a flavor of some of these arguments, see:

Raymond L. Garthoff, "ASAT arms control: still possible," *Bulletin of the Atomic Scientists*, August/September 1984, 29-34.

James E. Oberg, "A Dozen ASAT Fallacies," *Air Force Magazine*, July 1985, 79-81.

Paul B. Stares, "De' ja' vu: The ASAT Debate in Historical Context," *Arms Control Today* 13:11 (December 1983): 2-3.

Kosta Tsipis and Eric Raiten, "Antisatellite Weapons: The Present Danger," *Technology Review*, August/September 1984: 54-63.

17. A particularly succinct and eloquent work is Colonel Robert B. Giffen, *US Space System Survivability*, (Washington, D.C.: National Defense University Press, 1982).

18. *National Security Strategy of The United States* (Washington, D.C.: The White House, January 1987), 4.

19. John L. Piotrowski, "A Critical Juncture," *The Officer*, September 1989, 24.

20. Report that a hostile Middle East state directed radio interference at a U.S. satellite contained in James T. Hackett and Robin Ranger, "Proliferating Satellites Drive U.S. ASAT Need," *Signal*, May 1990, 156, cited in Thomas G. Mahnken, "Why Third World Space Systems Matter," *Orbis*, Fall 1991, 576.

21. See:

David J. Lynch, "Toward a New Launcher Lineup," *Air Force Magazine*, January 1993, 48-51.

Thomas S. Moorman, "Space: A New Strategic Frontier," *Air Power Journal* 6:1 (Spring 1992), reprinted in *Military Studies Course--MS 610: Book 3* (Maxwell Air Force Base, Alabama: Air War College, 1992), 211-215.

John M. Logsdon and Ray A. Williamson, "U.S. Access to Space," *Scientific American* 260:3 (March 1989), 34-40.

Neff Hudson, "Launch Delays Haunt Space Command," *Air Force Times*, 4 January 1993, 38.

22. Moorman, 215.

23. US Department of the Air Force, Office of the General Counsel, Letter, 3 February 1992, reprinted in *Space and Future Warfare--WS 633* (Maxwell Air Force Base, Alabama: Air War College, December 1992), 59-60; *AU-18, Space Handbook*, (Maxwell AFB, Alabama: Air University Press, 1985), reprinted in course materials for a 1993 Advanced Elective course at Air War College entitled "Space Issues," 126.

## BIBLIOGRAPHY

Aldhous, Peter. "Russian Space Science Limp On," *Science* 256 (12 June 1992): pp. 1508-1509.

Asker, James R. "U.S., Russian Space Pact Pledges Unprecedented Trade, Joint Flights," *Aviation Week and Space Technology*, 22 June 1992, pp. 24-25.

The Aspen Strategy Group, *Anti-Satellite Weapons and U.S. Military Space Policy*. Lanham, Maryland: University Press of America, 1986.

*AU-18, Space Handbook*. Maxwell AFB, Alabama: Air University Press, 1985.

Auster, Bruce B., et al. "The armed forces: How they line up," *U.S. News and World Report*, 5 April 1993, pp. 48-52.

"Baikonur Gets Bad Publicity," *Space News*, 16-22 November 1992, p. 1.

Bradsher, Keith. "Anxiety Slows Borrowing by Russia," *New York Times*, 29 September 1992.

Broad, William J. "Russia is Now Selling Spy Photos from Space," *The New York Times*, 4 October 1992, 10L.

-----, "U.S., To Cut Costs, Seeks Russian Role in Space Station," *The New York Times*, 7 April 1993, A1.

Brokaw, Tom. *NBC Nightly News*, 29 March 1993.

Burgess, John. "Satellites' Gaze Provides New Look at War," *The Washington Post*, 19 February 1991, A13.

Bush, Keith. "An Overview of the Russian Economy," *RFE/RL Research Report*, 1:25 (19 June 92), pp. 49-54.

Canan, James W. "A Watershed in Space," *Air Force Magazine*, August 1991, pp. 32-37.

-----, "Space Gets Down to Earth," *Air Force Magazine*, August 1990, pp. 30-34.

Charles, Dan. "Bargain Hunters Snap Up Russian Brainpower," *New Scientist*, 14 March 1992, p. 13.

Clausewitz, Carl von. *On War*. Edited and translated by Michael Howard and Peter Paret. Princeton, N.J.: Princeton University Press, 1976.

CNN, "Headline News, 20 January 1993, 4:30 P.M.

Coleman, Fred, et al. "Deja vu all over again," *U.S. News and World Report*, 8 March 1993, pp. 39-42.

Coll, Steve and Michael Dobbs. "The Free Market's Ugly Face," *The Washington Post National Weekly Edition*, 1-7 March 1993, pp. 10-11.

-----, "From Russia With Cash," *The Washington Post National Weekly Edition*, 15-21 February 1993, pp. 6-7.

Collins, John M. *Military Space Forces*. Washington, D.C.: Pergamon-Brassey's, 1989.

Corwin, Julie and Jeff Trimble. "Russia's Swords and Plowshares," *U.S. News and World Report*, 18 January 1993, pp. 54-55.

Covault, Craig. "Russia Seeks Joint Space Test to Build Military Cooperation," *Aviation Week and Space Technology*, 9 March 1992, pp. 18-19.

-----, "Russian/CIS Space Outlook Chaotic But Critical to Global Planning," *Aviation Week and Space Technology*, 16 March 1992, pp. 125-127.

-----, "Russians Forge Space Pact, But Military Transition Chaotic," *Aviation Week and Space Technology*, 13 January 1992, pp. 20-21.

-----, "Russians Locked in Struggle for Space Program Control," *Aviation Week and Space Technology*, 1 February 1993, pp. 57-59.

-----, "Russians Rejuvenate Military Space Assets," *Aviation Week and Space Technology*, 4 January 1993, pp. 54-55.

-----, "Soviet Military Space Center Offered for Commercial Lease," *Aviation Week and Space Technology*, 16 September 1991, p. 28.

-----, "U.S., Europe, Japan Vie For Russian High Technology," *Aviation Week and Space Technology*, 27 January 1992, p. 37.

-----, "USAF Urges Greater Use of Spot Based on Gulf War Experience," *Aviation Week and Space Technology*, 13 July 1992, pp. 61-65.

- Cremins, Tom and Elizabeth Newton. "Changing Structure of the Soviet Space Programme," *Space Policy*, May 1991, pp. 129-136.
- David, Leonard. "Boosters versus Bread Lines," *Ad Astra*, July/August 1992, p. 6.
- Department of Defense. *Military Forces in Transition*. Washington, D.C.: Department of Defense, 1991.
- Dornheim, Michael A. "France and Germany Will Help Fund Russian Mars 1994 Space Mission," *Aviation Week and Space Technology*, 25 May 1992, pp. 79-80.
- Dyson, Esther. "Just-so stories, or plain tales from Russia," *Forbes*, 14 September 1992, pp. 366-383.
- Freeland, Chrystia. "Ukraine Facing Economic Shifts," *The Washington Post*, 1 January 1993, A23.
- Galatowitsch, Sheila. "Squeezing the Most Out of Space," *Defense Electronics*, January 1993, pp. 50-54.
- Garthoff, Raymond L. "ASAT arms control: still possible," *Bulletin of the Atomic Scientists*, August/September 1984, pp. 29-34.
- Giffen, Colonel Robert B. *US Space System Survivability*. Washington, D.C.: National Defense University Press, 1982.
- Gilmartin, Patricia. "Gulf War Rekindles U.S. Debate on Protecting Space System Data," *Aviation Week and Space Technology*, 29 April 1991, p. 55.
- "Gloom, not doom," *The Economist*, 28 November 1992, pp. 16-17.
- Hamilton, David P. "In Space Technology, Small May Be Beautiful," *Science* 256 (12 June 1992): p. 1510.
- , "Skeptics Pour Cold Water On a Russian 'Fire Sale,'" *Science* 256 (12 June 1992): pp. 1510-1511.
- Harwood, William "Cosmonauts Tout Strength of Russian Space," *Space News*, 15-21 March 1993.
- Hiatt, Fred. "Bailing Out Russia," *The Washington Post National Weekly Edition*, 15-21 March 1993, pp. 8-9.

-----, "If Yeltsin Falls, Will the Cold War Rise From the Ashes?" *The Washington Post National Weekly Edition* 29 March-4 April 1993, p. 16.

-----, "Russians Favoring Retention of Nuclear Weapons," *The Washington Post* 13 November 1992, A1.

Hudson, Neff. "Launch Delays Haunt Space Command," *Air Force Times* 4 January 1993, p. 38.

Intourist Guide on author's visit to Moscow.

"Iraq Reportedly Hires Rocket Scientists," *Jornal Do Brasil* 31 July 1990, p. 3.

"Iraqi's Still Receive Weather Data From U.S. Satellites," *Aviation Week and Space Technology*, 21 January 1991, p. 26.

Jayaraman, K.S. "US leans on Russia to drop rocket agreement," *Nature* 356 (30 April 1992): p. 732.

Johnson, Nicholas L. *Soviet Military Strategy in Space*. New York: Jane's Publishing, Inc., 1987.

Johnson, Simon and Oleg Ustenko. "Ukraine on the Brink of Hyperinflation," *RFE/RL Research Report* 1:50 (18 December 1992), pp. 51-59.

Karatnycky, Adrian. "The Ukrainian Factor," *Foreign Affairs* Summer 1992, pp 90-107, reprinted in *International Security Studies--WS 635: Book 1*, (Maxwell Air Force Base Alabama: Air War College, March 1993), pp 64-70.

Kiernan, Vincent and Andrew Lawler. "Emirates Want to Buy U.S. Spy Satellites," *Space News* 16-22 November 1992, p. 1.

Kingwell, Jeff. "The militarization of space," *Space Policy*, May 1990, pp. 107-111.

Kruschev, Sergei. "Capitalism and Chaos: Russia's Next Implosion," *The Washington Post* 16 August 1992, C7.

Lawler, Andrew. "Proton Partnership Sparks Political Furor," *Space News* 4-10 January 1993, p. 1.

-----, "U.S. Pressures Russia to End Deal with India," *Space News*, 15-21 March 1993.

Lemonick, Michael D. "Space Program for Sale," *Time* 16 March 1992, pp 54-55.

Logsdon, John M. and Ray A. Williamson, "U.S. Access to Space," *Scientific American* 260:3 (March 1989), pp. 34-40.

Lynch, David J. "Toward a New Launcher Lineup," *Air Force Magazine*, January 1993, pp. 48-51.

Mahnken, Thomas G. "Why Third World Space Systems Matter," *Orbis* Fall 1991, pp. 563-579.

Marcus, Daniel J. "Firms Stretch Dollars in Russia," *Space News* 23-29 November 1992, p. 4.

"Mass Appeal," *The Economist*, 29 August 1992, p. 16.

McLean, Alasdair. *The Military Use of Space*. CENTERPIECE Number 19. Aberdeen, Scotland: Centre for Defence Studies, Summer 1991.

-----, *Western European Military Space Policy*, Brookfield, Vermont: Dartmouth Publishing Company, Ltd (Ashgate Publishing Company in US), 1992.

McPeak, General Merrill, Chief of Staff, United States Air Force. Speech to a gathering of senior officers at Maxwell Air Force Base, Alabama, June 1992.

-----, Interview with "Newsmaker Forum," *Space News* 15-21 February 1993.

Mecham, Michael. "Gulf War Rekindles European Interest in Developing Military Satellites," *Aviation Week and Space Technology*, 8 April 1991, p. 59.

"The Military's Use of Space Based Systems," *Signal*, March 1986, p. 47.

"Mission Control," *Military Space* 8:5 (11 March 1991): p. 1.

Moorman, Lieutenant General Thomas S. "Space: A New Strategic Frontier," *Air Power Journal* 6:1 (Spring 1992), reprinted in *Military Studies Course--MS 610: Book 3*, Maxwell Air Force Base, Alabama: Air War College, 1992, pp. 211-215.

*National Military Strategy 1992* Washington, D.C.: Joint Chiefs of Staff, 1992.

*National Security Strategy of The United States* Washington, D.C.: The White House, January 1987.



*National Security Strategy of The United States* Washington, D.C.: The White House, January 1993.

Oberg, James E. "A Dozen ASAT Fallacies," *Air Force Magazine*, July 1985, pp. 79-81.

-----, "PSST! Wanna buy a Spaceship?" *Omni* 14 (January 1992): p. 12.

Piotrowski, General John L. "A Critical Juncture," *The Officer*, September 1989, pp. 19-24.

Pope, Victoria. "Back to the Future in Central Asia," *U.S. News and World Report*, 8 March 93, pp. 42-44.

Raghuvanshi, Mike. "India's Civil Space Budget Gets 14 Percent Increase," *Space News* 15-21 March 1993, p. 7.

Rich, Vera. "Soviet Space Saver," *New Scientist*, 14 March 1992, p. 13.

"Russian Arms Trade," *The Washington Post*, 23 February 1993, p. A4.

Sachs, Jeffrey D. "It's Time for the West to Put Up," *The Washington Post National Weekly Edition*, 5-11 April 1993, p. 24.

Seitz, Patrick. "Short, Sharp Increase in Launch Activity Expected in 1995," *Space News* 15-21 March 1993, p. 18.

Selding, Peter B. de. "Krunichev, Salyut Rivalry Threatens Proton Marketing," *Space News* 15-21 March 1993, p. 1.

-----, "Low-Cost Proton Purchase Confirms Competitor's Fears," *Space News* 16-22 November 1992, p. 29.

-----, "Plethora of Russian Capsules to Become Available," *Space News* 30 November-6 December 1992, p. 24.

Shifrin, Carole A. "Geopolitical Changes Spark New Strategies," *Aviation Week and Space Technology*, 7 September 1992, pp. 54-55.

Simes, Dimitri. "What Clinton Must Do To Aid Democracy in Russia," *The Washington Post National Weekly Edition*, 8-14 February 1993, pp. 24-25.

Smith, Bruce A. "Russians May Boost Civil Space Funding," *Aviation Week and Space Technology*, 14/21 December 1992, p. 54.

Smith, Marcia S. Congressional Research Service, interview with "Newsmaker Forum," *Space News* 23-29 November 1992, p. 22.

----- . Personal interview with author in Washington, D.C., 22 December 1992.

----- . *Military Space Programs in a Changing Environment: Issues for the 103d Congress* CRS Report for Congress No. 92-879 SPR. Washington D.C.: The Library of Congress, Congressional Research Service, 1 December 1992.

----- . *Prospects for the Post Soviet Space Program*. CRS Report for Congress No. 92-123 SPR. Washington D.C.: The Library of Congress, Congressional Research Service, 4 February 1992.

----- . *Russia/U.S. Space Interaction: A Trip Report with Observations and Options*. CRS Report for Congress No. 92-774 SPR. Washington D.C.: The Library of Congress, Congressional Research Service, 27 October 1992.

----- . *Space Activities of the United States and Other Launching Countries/ Organizations: 1957-1991*. CRS Report for Congress No. 92-427 SPR. Washington D.C.: The Library of Congress, Congressional Research Service, May 11 1992.

Stanglin, Douglas and Victoria Pope. "Two cheers for demokratiya," *U.S. News and World Report*, 5 April 1993, pp. 42-46.

----- . "The Wreck of Russia," *U.S. News and World Report*, 7 December 1992, pp. 40-49.

Stares, Paul B. "De' ja' vu: The ASAT Debate in Historical Context," *Arms Control Today* 13:11 (December 1983): pp. 2-3.

Tsipis, Kosta and Eric Raiten, "Antisatellite Weapons: The Present Danger," *Technology Review*, August/September 1984: pp. 54-63.

US Department of the Air Force, Office of the General Counsel. Letter, 3 February 1992, reprinted in *Space and Future Warfare--WS 633*. Maxwell Air Force Base, Alabama: Air War College, December 1992), pp. 59-61.

Vice President's Space Policy Advisory Board. *The Future of the U.S. Space Industrial Base--A Task Group Report* Washington, D.C.: The White House, November 1992.

Zhdakayev, Sergei. "A Job No Longer Lasts Forever," *Isvestia* in *World Press Review*, November 1992, pp. 11-12.

DISTRIBUTION REQUEST FOR AIR WAR COLLEGE RESEARCH

NAME(S) AND GRADES(S) OF AUTHOR(S)

GREGORY A. KEETHLER, LT COL, USAF

FORWARDING ADDRESS(ES) AND TELEPHONE NUMBER(S) OF AUTHOR(S)

7870 CHIMNEY TERRACE  
COLORADO SPRINGS, CO 80920  
PHONE: (915) 755-7962

EXACT TITLE AS IT APPEARS ON TITLE PAGE

THE IMPACT OF THE SOVIET UNION'S DEMISE ON THE US <sup>MILITARY</sup> SPACE PROGRAM

KEY WORDS (LIST WORDS THAT INDICATE THE SUBSTANCE OF YOUR SUBJECT)

CIS, SPACE, SPACE PROGRAM, RUSSIA, SPACE CONTROL,  
SPACE STRATEGY, MILITARY SPACE

CLASSIFICATION: (CIRCLE) UNCLASSIFIED CONFIDENTIAL SECRET TOP SECRET

List complete addresses of organizations to receive this report other than our standard distribution: Air University Library, all senior service school libraries, Air Force Academy Library, Defense Technical Information Center, and Defense Logistics Studies Information Exchange.

PUBLICATION: Submit this report for publication to the following academic or professional journals. Provide complete address(es) and telephone number(s).

APPROVAL AND RELEASE

ADVISOR'S PRINTED NAME AND SIGNATURE

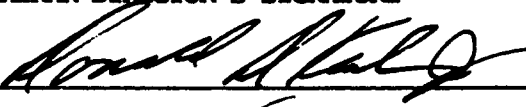
BOX #

150

SIGNATURE(S) OF AUTHOR(S)

*Gregory A. Keethler*

SEMINAR DIRECTOR'S PRINTED NAME AND SIGNATURE

AIR WAR COLLEGE PROFESSIONAL WRITING PROGRAM PROPOSAL			DATE:
NAME AND GRADE: Keethler, Gregory A. Lt Col	BOX # 150	SEMINAR # 17	SEMINAR DIRECTOR'S NAME AND GRADE Colonel Don Karle
OTHERS, IF ANY, WHO ARE WORKING ON THIS STUDY None			
TITLE Changes in the CIS Space Program and Their Implications for U.S. Military Space Strategy			
SPECIFICALLY IDENTIFY THE RESEARCH QUESTION, HYPOTHESIS, AND PROPOSAL. <p>What changes are taking place in the former Soviet Space Program and how do these changes affect U.S. Military Space Strategy? The hypothesis is that the space program in the CIS is shifting and will continue to shift from a primarily military orientation to a commercial one. More specifically, the former Soviet Space Program will turn to marketing its various services worldwide in order to earn hard currency and keep itself afloat. The resulting changes in the CIS Space Order of Battle should impact U.S. Space Strategy, particularly investment strategy. I propose to investigate specifics of current and likely changes in the CIS Space Program and, in light of these changes, examine appropriate adjustments to U.S. Military Space Strategy.</p> <p style="text-align: right;">APPROVED P. H. Walsh, Jr.</p>			
APPROVALS		SEMINAR DIRECTOR'S SIGNATURE	
RESEARCH ADVISORS PRINTED NAME Colonel Kenneth Walsh		 OFFICE OF THE DEAN OF ACADEMIC AFFAIRS	
RESEARCH ADVISORS SIGNATURE 